



TRANSFUSION

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TRANSFUSION :

Its History, Indications, and Modes of Application.

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BY

CHAS. EGERTON JENNINGS, L.R.C.P. LOND.,

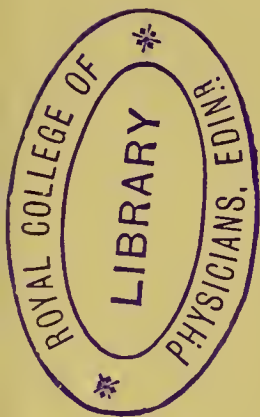
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*WITH ENGRAVINGS ILLUSTRATING THE AUTHOR'S
SYPHON FOR INTRAVENOUS INJECTION
AND IMMEDIATE TRANSFUSION,*

AND

A BIBLIOGRAPHICAL INDEX.



LONDON:
BAILLIÈRE, TINDALL, AND COX,
20, KING WILLIAM STREET, STRAND.

1883.

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P R E F A C E.

IN presenting this publication to the Medical Profession, I would fain offer the apology adopted by the popular Author of "Vice Versâ," for I feel myself in the position of that Greek nobleman who, having invited a number of distinguished guests to attend the funeral of his infant daughter, apologized for bringing so small a corpse before so august an assembly.

In this short essay I have endeavoured to point out those classes of cases where Transfusion would probably be followed by only temporary benefit—those where it is obligatory on the practitioner, and, when properly performed, usually successful—as well as the fallacies and dangers attendant on the operation, *with the means of obviating them.*

I very gratefully acknowledge many valuable suggestions I have received from my friend, DR.

FENTON JONES, with reference to the "Transfusion Syphon," illustrated in these pages, and, whilst commending this instrument to the notice of the reader, would remark that, in its production, my object has been not merely to simplify the operation of Transfusion, but to render it one of certainty and safety.

CHAS. EGERTON JENNINGS.

8, NICHOLAS STREET, E.,

January, 1883.

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TRANSFUSION.



CHAPTER I.

INTRODUCTION.

STUDENTS, with smiling faces, are rapidly leaving the theatre of one of our metropolitan hospitals. The most brilliant operator of the day has just performed immediate transfusion with the greatest success. By means of a very beautiful instrument, the most complex and ingenious that modern science has as yet produced, a skilful surgeon has transfused half a pint, or perhaps a pint, of blood from a healthy individual to a fellow-creature profoundly collapsed from the effects of severe hæmorrhage. Some little difficulty was experienced prior to the operation, as one of the many stop-cocks of the transfusion apparatus was found to work stiffly ; but this error was quickly rectified by a mechanic in attendance. Towards the close of the operation the blood-donor, a powerful and heavy young man, swooned. Two porters carried him on a stretcher into an adjoining room, his wounded arm being bandaged up, *secundum artem*, by energetic

dressers. Diffusible stimuli were exhibited by the mouth, nostrils, rectum, and skin. The man rallied in due course, being well cared for by a group of students and nurses, deputed to look after him. The wound in his arm will probably heal speedily, or a few weeks later he may possibly apply at the out-patient department of the hospital, presenting an ugly-looking pulsatile tumour, associated with a thrill and rasping bruit, connected with the vessels in the cubital triangle, a most unfortunate accident having clearly happened here, of which a record promptly appears in the columns of the *Lancet*. Time rolls on, and a spectator of the duplex operation, possessed of an instrument such as he had seen employed, finds himself at midnight, in a lone house in the country, face to face with an alarming case of post-partum hæmorrhage. He has adopted the modes of treatment recognised as judicious for the condition before him. He has employed active hæmostatic agents, and finally that potent but highly dangerous styptic perchloride of iron. His patient is blanched and collapsed to the last degree. Are not her bloodvessels so thoroughly drained of blood, that there is not sufficient of that element circulating in the uterine walls to stimulate to *permanent* contraction its muscle fibres? Is not this the very case for transfusion? The accoucheur puts his apparatus in order (he may not have it with him, and be obliged to send home for it), and selects a blood-donor. He has little time or opportunity, under the circumstances I have depicted, to find an

adolescent, healthy beyond a doubt ; little time has he to eliminate the existence of syphilis or of other specific communicable diseases by a well-planned examination of the youth, or to obtain a knowledge of his previous history and mode of life. The operation is commenced ; the blood-donor faints ; the friends of the patient, the necessarily improvised assistants to the accoucheur, faint also. The operation is abandoned, and it and he who proposed it fall into disrepute. But there may fortunately have been time to summon a skilled assistant. The veins, both of blood-giver and recipient, may have been dexterously opened, and transfusion commenced. Still accidents may even now happen : a small coagulum may form within the apparatus, or a little air gain access through some contingency to the veins operated on.

The picture is carried far enough. Is the operation of immediate transfusion, as taught and elaborately performed in hospital practice, where there is every means of ensuring success, one of universal application ? Is it one that can always be performed when most needed—under urgent circumstances and at a moment's notice, often in the night, at Land's End, John o'Groat's House, or Ratcliff Highway, and by an unaided operator, with everything against him ? *

It is in obstetric practice that the operation is most frequently demanded ; there are numbers of cases on

* Jennings. *Lancet*, 1882, vol. ii. pp. 485, 486.

record where a precious life has been snatched from destruction beyond all question by a timely transfusion ; there are many where the patients were positively *in articulo mortis* when the operation was commenced—cases in which the fresh lease of life can be fairly attributed to transfusion and to nothing else ; more still there are, unfortunately, where women in childbed have succumbed to hæmorrhage, without this, the sole chance of salvation, having been extended to them.

Can the profoundest sceptic or the greatest therapeutic Nihilist of the age dispute the veracity of these assertions ? Ought not a death from ante-partum or post-partum hæmorrhage to be regarded as a blot on the escutcheon of British midwifery ?

The sceptic retorts that there are doubtless not a few cases where transfusion has proved fatal. Have not patients expired during the operation with all the manifestations of air in the veins ? Has not an autopsy sometimes revealed pulmonary embolism and thrombosis ? Is not transfusion, especially the immediate method, altogether too grave a procedure to be undertaken by a practitioner single-handed ? Away, thou *bête noir* ! Utter not such remarks among thy *confrères* ! Speak not thus before the learned societies where the *savants* do congregate ! If the parturient woman did expire suddenly whilst transfusion was in progress, was not her uterus also being injected with hot water to check the hæmorrhage, and may not air have readily gained access to the venous

system *viâ* the uterine sinuses *vice* the vein of the arm?

If she died from embolism, was not a styptic injection of perchloride of iron employed, and the embolus produced thereby, and not from any fibrination in the transfusion apparatus, as thy malevolence suggesteth? The critic is silenced, but not convinced.

Due importance must, however, be attached to these practical, well-founded, and just objections. To elevate transfusion from its theoretical position in the healing art, and from its doubtful value in medicine as a therapeutic measure, the operation must be simplified. As a rule blood-transfusion should be dispensed with, and an artificial substitute found. All complex instruments must be abandoned, and a method devoid of danger and of easy application employed. Then, indeed, will physicians rejoice in a considerable increase to their territory, and surgeons in the addition of an important item to their list of conservative operations.

This train of thought forced itself upon me very strongly when in a case I have recorded,* and to which I shall refer hereafter, I injected sixteen ounces of a saline alcoholic fluid into the median basilic vein of a patient of the London Hospital Maternity Charity, for severe ante-partum hæmorrhage, with the best result; adopting this method not by election, but by compulsion, for although in London and on a Sunday

* Page 25.

afternoon, I was unable to procure a blood-giver at a moment's notice.

From reading the literature on the subject, I believe that this method merits the highest commendation, and as far as our knowledge goes, outstrips all others in point of efficacy, safety, and ease of application. With the view of promoting still further these desirable objects, I have devised a syphon for intra-venous injection and a modified form of cannula, in order to secure the advantages and to discard the objections which the apparatus for transfusion possess.

Having published this method in the journals, and having demonstrated it before many of the leading scientific societies in this country, it has been suggested to me to write a small monograph, combining the opinions I entertain in a *résumé* of "Transfusion;" hence the appearance of this short essay.

Yet one word more. Since transfusion is so often called for in midwifery for ante-partum and post-partum hæmorrhage, and to ensure success the operation is an important, though by no means the *sole* part of the treatment which must be adopted; and since obstetricians hold very diverse opinions as to the proper *modus operandi* for this class of cases, I consider it quite within my province to dilate on this topic freely; and having formed my conclusions thereon after careful deliberation, and some experience of these hæmorrhages, I may perhaps be pardoned if I advance my views somewhat dog-

matically, and criticize keenly, though temperately, those of others.

It cannot be of practical utility to produce statistics of all the cases of transfusion recorded up to the present time ; but it will probably be advantageous to select examples—some successful, others unsuccessful, and endeavour to show the causes of the results obtained—that some definite ideas may be derived therefrom as to the indications and most suitable methods for transfusion, and as these few pages are written apart from the bias of pre-formed opinion, the reasons *pro* and *con* will be impartially, though perhaps imperfectly, set forward.

CHAPTER II.

ITS HISTORY.

THAT empirical treatment is so often adopted before a rational basis is known, is well exemplified in transfusion; for whilst the work *De motu cordis et sanguinis in animalibus* of the immortal Harvey appeared in 1628, transfusion was *attempted* at least as early as 1492. I say *attempted*, for the operation proved a complete failure:

“The vital powers of Innocent VIII. rapidly gave way; he had for some time fallen into a kind of somnolency, which was sometimes so profound that the whole Court believed him to be dead. All means to awaken the exhausted vitality had been resorted to in vain, when a Jew doctor proposed to do so by the transfusion, by a new instrument, of the blood of a young person, an experiment that had hitherto only been made on animals. Accordingly, the blood of the decrepit old pontiff was passed into the veins of a youth, whose blood was transferred into those of the old man. The experiment was tried three times, and at the cost of the lives of the three boys, pro-

bably from air getting into their veins, but without any effect to save that of the Pope." *

Surely such a record "points a moral, and adorns a tale ;" it would, however, be most unfair for us whose physiological, pathological, and therapeutic knowledge has been in great part derived from the errors and mishaps of those who have preceded us—errors which, though perfectly justifiable in them, would be quite inexcusable in us—to criticize unduly the first endeavours made nearly four hundred years ago to perform an operation which even now, for its due accomplishment, requires not only knowledge, but skill, deliberation, and decision.

Harvey's discovery of the circulation, in the seventeenth century, was followed by Lower's demonstration in this country in 1665 of a case of immediate transfusion in the dog.

"First, Take up the *Carotidal* Arterie of the Dog, or other Animal, whose Bloud is to be transfused into another of the same or a different kind, and separate it from the Nerve of the Eighth pair, and lay it bare above an inch. Then make a strong Ligature on the *upper* part of the Arterie, not to be untied again : but an inch below, *videl.* towards the Heart, make another ligature of a running knot, which may be loosened or fastened as there shall be occasion. Having made these two knots, draw two threads under the Arterie between the two ligatures ; and then open the Arterie, and put in a Quill, and tie the Arterie upon the Quill

* Villari, "Life of Savonarola." Cf. *Medical Times and Gazette*, 1865, vol. ii. p. 81.

very fast by those two threads, and stop the Quill with a stick. After this make bare the *Jugular* vein in the other Dog about an inch and a half long, and at each end make a ligature with a running knot, and in the space betwixt the two running knots draw under the Vein two threads, as in the other: then make an Incision in the vein, and put into it two Quills, one into the *descendent* part of the vein, to receive the blood from the other dog and carry it to the Heart; and the other Quill put into the other part of the *Jugular* Vein which comes from the Head (out of which, the second Dog's own blood must run into Dishes). These two Quills being put in and tyed fast, stop them with a stick, till there be occasion to open them.

“All things being thus prepar'd, the dogs on their sides towards one another so conveniently, that the Quill may go into each other (for the Dogs' necks cannot be brought so near, but that you must put two or three several Quills more into the first two to convey the blood from one to another). After that unstop the Quill that goes down into the first dog's *Jugular* vein, and the other Quill coming out of the other Dog's Artery; and by the help of two or three other Quills put into each other, according as there shall be occasion, insert them into one another. Then slip the running knots, and immediately the blood runs through the Quills, as through an Arterie, very impetuously. And immediately as the blood runs into the Dog, unstop the other Quill, coming out of the *upper*

part of his *Jugular* vein (a ligature being first made about his neck, or else his other *Jugular* vein being compressed by ones Finger) ; and let his own blood run out at the same time into Dishes (yet not constantly, but according as you perceive him able to bear it) till the other Dog begin to cry, and faint, and fall into Convulsions, and at last dye by his side.”*

Though transfusion was first performed on animals in England by Lower in 1665, the method was previously conceived in France in 1651.

At a meeting of one of the learned societies held at Paris in July, 1658, there were present, among others, the following distinguished personages : Jean Denis, a professor of mathematics and philosophy ; Paul Emmerez, a skilled surgeon ; Claude Tardy, physician to the Duc d’Orleans ; and Robert des Gabets, a monk of the Benedictine Order.

Des Gabets, on being asked to speak, astonished the audience by annunciating some marvellous ideas which he had for a long time pondered over. Referring to the then recent discovery of the *circulation* by Harvey, he felt convinced that he could establish another movement of the blood, *communication*, by which he meant “ the efficient passage of the blood of a healthy man or other animal to the veins of an individual weak or diseased.” A friar, Éloy Pichot, had made for Des Gabets, seven years previously, an instrument consisting of two small silver cannulæ,

* *Philosophical Transactions*, Monday, Dec. 17, 1666, p. 353, *et seq.*

connected by a leather purse about the size of a walnut, the cannulæ being each guarded at one end by a valve, so that, by pressing gently with two fingers on the purse, the blood, in its transit, could not return into the emittent, but would be forced onwards into the afferent vein. "The purse has the additional advantage of estimating the quantity of blood communicated."

In a letter written by Jean Denis (dated March 2nd, 1668) to M. Sorbière, the former vindicates the honour of France in regard to this splendid discovery, and asserts that some English noblemen, who were present at Des Gabets' demonstration of it, were much interested, so that it was not to be wondered that the discovery should pass from France to other countries. "It is indisputable," continues Denis, "that the English merit the honour of having profited by the idea the French have neglected, they" (the English) "having first practised the operation on dogs with success. But it must be conceded that it was in France that the method was first originated."

In March, 1667, Denis and Emmerez publicly transfused from dog to dog. The experiment was varied and repeated *ad infinitum*. Sometimes blood was transfused from artery to artery, sometimes from vein to vein, from artery to vein, or again from vein to artery, the operations being attended with the best results. The system of transfusion was developed a stage further a few days later, for Denis and Emmerez transfused from a calf to a dog. At length,

on June 15th, 1667, Denis and Emmerez essayed transfusion on man. The operation was performed on the person of a youth, *æt.* fifteen or sixteen, "who had been tormented for more than two months with an intractable and violent fever." The historian does not exactly state what the indications for the operation were, but complete success attended the transfusion of nine ounces of blood from the carotid of a lamb to the vein of the young man's arm.

On Nov. 23rd, 1667, the English performed transfusion for the first time on a human being. Nine or ten ounces of blood supplied from the carotid of a lamb were transferred into the veins of the arm of one Coga.*

An unfortunate man, Antoine Mauroy, aged thirty-four, who had been imbecile since the age of seven or eight, and who lived a few leagues from Paris, was wont to appear in that capital and amuse the juvenile portion of the populace with his eccentricities. His last extravagance was to escape one day from his wife's control, parade the streets of Paris, clothed only in nature's garb, followed by an admiring throng. Such an opportunity was not to be lost. Is there not a proverb, '*Fiat experimentum in corpore vili*'? The enthusiastic Denis pounced upon this luckless wight, finding him in the Marais du Temple, "half covered with old rags, girt with many bands of straw, without shirt or drawers, without breeches or shoes, the face bedaubed with charcoal, and followed in this plight

* *Philosophical Transactions*, Dec. 9th, 1667 (No. 30), p. 557.

by a crowd of children, who were running after him."

On December 19th, 1667, at 6 p.m., Emmerez laid bare the crural artery of a calf, and drew 10 ounces of blood from a vein of the fool's right arm, substituting for it 5 or 6 ounces derived from the calf.

Two days later, the operation was repeated; now only 2 or 3 ounces were abstracted, but nearly a litre of calf's arterial blood was transferred.

Two days later still, with the view of transfusing more blood, a cannula was inserted into a vein of the man's arm, blood being drawn simultaneously (for this was considered indispensable) from a vein of the leg. As the flow of blood was bad, the operation was abandoned; the man died the same evening.

The record of this case is not sufficiently explicit to justify any deduction therefrom; nevertheless I shall bring evidence to show* that the introduction of alien corpuscles into the vascular system is always dangerous, and if the quantity so introduced be large, fatal. There is, I think, every probability that this madman might have survived the first transfusion ("five or six ounces"), but that "nearly a litre" of the quantity of calf's blood transfused at the second operation proved a mortal dose.

The reader will not be surprised to hear that the enemies of transfusion, who were numerous, most unmercifully attacked the poor experimentalists. The Faculty of Medicine at Paris, who, we are told, was

* Chapter III.

opposed to every kind of progress, who still refused to recognise the Harveian circulation, who had rejected antimony and quinine, but had contented themselves with the Hippocratic physiology—who had beheld with anguish science drawn beyond their school, and believed themselves to be the everlasting depository of medical lore—this Faculty, without directly meddling in the matter, subtly set many of its members to work, who anonymously published pamphlets against Denis and Emmerez.

These physicians are even accused of having bribed the widow of the unfortunate lunatic to charge the operators with the death of her husband. The scandal assumed colossal proportions. The widow Mauroy, goaded by cupidity rather than marital affection, pressed the matter with such assiduity that Denis, in self-defence, lodged a complaint against the widow and those who supported her, in court. Denis appeared as the plaintiff, and not as the defendant, as commonly reported.

The court,[†] whose jurisdiction extended alike over civil and criminal matters, prohibited the performance of the operation in future, save with the sanction of the Faculty of Medicine.*

Various apparatus[†] have been proposed for immediate transfusion. Denis's cannulæ have already been described. Boehm connected them with a small piece of intestine, as, for instance, that of a fowl, by

* S. Chereau, *L'Union Médicale*, Sept. 8, 1874, p. 373, *et seq.*

† This description is borrowed largely from South's *Chelius*, vol. ii. p. 877, *et seq.*

stroking which the passage of the blood might be encouraged. Instead of intestine, Regner de Graaf connected the two tubes with a piece of artery dissected from a beast, to which there was a side branch, partly to allow the escape of the air, and partly to note the constant stream of the outflowing blood. Von Graefe's apparatus consisted of a glass cylinder filled with warm water at a temperature of 97° F., and furnished with a cock for the escape and renewal of the water, and through which a glass tube passes for carrying the blood ; this tube joining at one end another, curved and shouldered, for insertion into the artery of a beast, and at the other an elastic tube to be attached to the cannulæ already inserted into the patient's vein.

"Infusion, in contradistinction to transfusion, mentioned by Magnus Pegelius and Libavius in 1615, and practised on a dog by a Captain G. von Wahren-dorff in 1642, was first subjected by Ch. Wren, who first performed it on a malefactor in 1656, to philosophical examination. The English physicians Clark, Lower, and others, made experiments with it upon brutes ; Major, in 1664, and Elsholz, in 1665, first employed it on men ; Schmidt, Purmann, and V. Sarpi especially occupied themselves with it. However, it soon sank in the estimation of physicians, and has only of later years been employed in a few cases in Germany by Köhler, Hemran, Meckel, and others. After the early cases and his own experiments in Germany by Graefe and Horn, and by Laurent and

Peray in France on men, Bichat, Nysten, Seiler, Magendie, Orfila, and Dieffenbach instituted some exceedingly interesting and, for physiology, important experiments upon the injection of different kinds of matters into brutes, and have employed this operation on man, as, for instance, in tetanus and cholera."

In stubborn nervous diseases, such as epilepsy, affections of the mind, hysteria ; in dyscrasic diseases, syphilis, gout, obstinate diseases of the skin ; in typhus and intermittent fevers, infusion has been tried, and very different remedies have been injected. Narcotic remedies, as belladonna, opium, hyoscyamus, stramonium, and also digitalis and strychnine, have generally dared only to be given in two-thirds of their ordinary dose ; salt is borne in large quantity. "They have the same effect as if taken into the stomach, though their operation is mostly very irregular."

Early in this century* Dr. Blundell increased the knowledge on the subject of transfusion by means of many experiments on dogs.

These experiments not merely corroborated those already made by others as to the success of direct and indirect transfusion, but also conclusively proved that so far as lower animals are concerned at least, it is an unsound and dangerous practice to transfuse alien blood.

Dr. Blundell's transfusion apparatus or "gravitater"

* *Transactions of the Royal Medical and Chirurgical Society*, vol. ix. p. 56, *et seq.*

consisted of four different parts : the syringe, the cup, the tubes, and the frame.

I choose to refer the reader to the original record rather than give an exact description of this useful, but complicated, machine.

In late years the methods for transfusion have been much perfected by the labours of many eminent men.

It is beyond the scope of this small treatise to attempt to describe or even enumerate all these methods, for their name is legion ; but perhaps at the present time the instruments most generally known and used are those of Roussel, Aveling, Hewitt, Little, Hamilton, Hicks, MacDonnell, Hime, and Monocq. The object of the following pages will be to endeavour to point out the strong and weak points in these various forms of apparatus, which they in common with every other surgical instrument must possess, in the earnest hope that by such a criticism, conducted in the spirit of investigation, some practical deductions may be derived and possibly prove hereafter of service and benefit to mankind.

CHAPTER III.

ITS PROSPECTS AND ITS INDICATIONS.

By combining the tables given by Bellina, Asché, and Leisrink we get a total of 243 cases in which transfusion was performed for acute or chronic anæmia prior to the year 1873. Of these 243 cases, 143 (46·9 per cent.) terminated in complete recovery ; in 34 cases (14 per cent.) the operation was followed by temporary benefit, but failed to save life ; in 95 cases (39·1 per cent.) no beneficial result whatever was achieved. Accordingly, transfusion failed in a little over a third of all these cases, while in nearly two-thirds of the total number it was followed by improvement or recovery. These figures would suffice as they stand to justify the operation, even if we did not know that it had almost invariably been resorted to in desperate cases. If we examine more closely into the details of each failure, we find that in a vast majority of them death cannot be ascribed directly or indirectly to the operation, but was due to other causes. An accurate sifting of these cases is, however, impracticable, for the estimate of the

probable duration of the patient's life in each case, supposing transfusion not to have been performed, would be too much at the mercy of the individual judgment of the critic. I may therefore leave the reader to consult the original records for himself, and arrive at an independent opinion on the subject.

In 113 of the cases alluded to above the operation was performed on account of hæmorrhage during or immediately after delivery. Of these 113 cases 67 ended in complete recovery, 7 showed only a temporary improvement, while 39 terminated fatally, without any sign of previous amendment. A positive result was thus achieved in 65·5 per cent., or two-thirds of all the cases belonging to this category. Of this proportion 59·7 per cent. were recoveries, while in only 6·2 per cent. was the improvement temporary. As the recoveries amount to more than half of the total number of cases, the obstetrician must consider transfusion obligatory whenever acute anæmia of sufficient severity to threaten life sets in as a result of hæmorrhage during delivery, the hæmorrhage itself having been arrested.*

If further evidence be needed in favour of the prospect of success which may be anticipated from transfusion, let me quote Roussel's experience :

"Table of 50 direct transfusions, performed by Dr. J. Roussel, from 1865-1877. Subjects, 37 men, 12 women, and 1 child. Results, 26 complete recoveries,

* Cf. Ziemssen, *Cyclopædia of the Practice of Medicine*, xvi. p. 477.

14 partial successes, 10 unsuccessful, in every case after some amelioration.”*

From a close scrutiny of the splendid series of cases of which this paragraph forms the heading—a series of cases in which, like those reported by Bellina, Asché, and Leisrink, the operation was performed for all “sorts and conditions of men,” both in hospital and in private practice, as well as from careful observation of those cases of transfusion I have witnessed at the London Hospital, I submit the following propositions :

1. That the direct method is only applicable to a few out of the many cases in which transfusion is demanded, and, as a rule, should only be attempted by a skilled surgeon, with skilled assistance and hospital appliances at his disposal.

2. Saving the possibility of accidents, transfusion, when properly performed, is most successful in those cases of severe hæmorrhage, unaccompanied by shock (or the shock, if present, being consecutive to the hæmorrhage), in which the bleeding can be checked.

3. No *permanent* benefit can be anticipated from the operation in those cases where shock is present, as, for instance, after amputation at the hip.

4. It is also useless for small repeated hæmorrhages, unless the cause of those hæmorrhages be removable, as in a case of retained placenta.

5. The immediate causes of failure are these : 1st,

* Roussel, *Transfusion of Human Blood* (English Translation), p. 89.

the entrance of air to the vein operated on ; 2nd, coagulation of the blood ; 3rd, the introduction into the vascular system of fluids which act deleteriously on the blood ; 4th, the complexity of the method employed, and the impossibility of always procuring skilled assistance when required.

6. Saving these causes of failure, *which can all be obviated*, the dangers of the operation, *per se*, are small, and are not greater than those which attend venesection and other minor operations on the venous system.

Ample proof is afforded by means of experiments which have been made on the veins of dogs* that these vessels will readily tolerate operative procedures. If corroboration be needed, the many successful cases of phlebotomy recorded, as well as the success which usually follows operations for varicocele and hæmorrhoids, prove that operations on veins of small and medium size are usually attended with but little danger.

It is for ante-partum and post-partum hæmorrhage that transfusion is most frequently and most imperatively demanded ; and as the proper *modus operandi* for these dangerous conditions is still unsettled, and not by any means so clearly stereotyped as is the treatment for those kinds of hæmorrhage which come under the surgeon's notice, I quote, by way of comparison, two cases.

CASE No. I.—Mrs. A——, *æt.* 38, mother of

* Callender, *Holmes' System of Surgery*, 1870, vol. iii. p. 358.

six children.* She had been in poor circumstances lately. She was nearly at full term of pregnancy. While at a neighbour's house, she was noticed hysterically laughing, and then to be confused in mind for a few minutes. A large pool of blood was found beneath her; she moved about the room, making three pools of blood; she was ghastly pale, and was taken home, where another pool of blood was found on the floor. She was placed in bed, and my clerk, Mr. Booth, found her pulseless; the os uteri was the size of a crown-piece. She continued pulseless an hour, when there was some slight attempt at reaction, and the pulse could be felt as a fine thread, beating 120 p.m. Two hours after the attack I saw her. There had been but little loss since. The os was the size of a crown-piece, but not dilatable. Her depression was so great, that the examination caused a marked subsidence of the pulse. I ruptured the membranes and gave stimulants freely. The surface was cold, and warmth was applied without result. However, after four or five hours the face regained its colour, and the pulse somewhat improved in volume. There was no hæmorrhage going on externally or internally, as far as could be ascertained. A dose of secale was given to hasten uterine action. Vomiting followed with increased frequency of pulse, which was now beating at 130-140 p.m. In another hour a marked depression of power of pulse again

* Braxton-Hicks, *Guy's Hospital Reports*, 3rd series, vol. xiv. 1869, pp. 8, 9.

ensued, with jactitation and attempts to rise, the expression of face was drawn, and the breath cold ; once the pulse vanished for some time.

I therefore transfused, taking blood from the husband. Six ounces were injected, the result being very marked. For the pulse, from being almost imperceptible, became quite distinct ; the jactitation diminished ; the breathing steady and quiet. The difficulty of operating was very great, owing to the almost complete absence of domestic appliances.

A slight increase of blood loss again occurring, I thought it best to complete delivery as soon as it could be effected consistently with the safety of the patient. I found the uterus in moderate action, and os fully expanded. I therefore applied the long forceps, but owing to the fatty state of the lower part of the uterus, it was somewhat difficult to pass the lower blade. I therefore removed it, and employed combined internal and external version, by which the child was turned easily in a minute, and then *gently drew down* the child, the uterus contracting after it. But after the whole ovum had been expelled *the uterus ceased to contract*. Some slight bleeding ensued ; I passed my hand into the uterus, cold water was injected into its cavity, but she was reduced to the last stage. She lingered on some little time during which I made another attempt to transfuse, but as the supply of blood was very slow, coagulation interfered, and practically only a very small quantity entered the veins. She shortly after died, about ten

hours after the first occurrence of the hæmorrhage. The process of delivery in these cases of extreme exhaustion is very depressing, and adds enormously to the risks of the case.

The cause of failure appears to lie in the words I have italicized. Dr. Braxton-Hicks does not say he *expressed* the child, and after delivery the uterus *ceased to contract*. The sequence of events was as follows :

From the profound loss of blood, the uterus was in an atonic condition, so that it could not contract to expel the child. The tone of the uterus was in some measure restored by transfusion, but *not to an extent sufficient* to warrant the obstetrician in emptying the organ by an artificial procedure, with the *rapidity* which the description of the case implies. Hence the cause of the post-partum hæmorrhage.

CASE NO. II. — On August 20th,* at about 3 p.m., M. A. S——, a patient of the London Hospital Maternity Charity, pregnant and nearly at term, fell in the courtyard adjoining her house, suddenly becoming the subject of profuse ante-partum hæmorrhage. At 5 p.m., I found her collapsed to a marked extent, lying on a sofa in her bedroom, the pulse barely perceptible, the skin cold and clammy, extreme pallor of the face, an anxious expression of countenance, sighing respiration, and slight jactitation. Blood was flowing from the vagina ; the mucous membranes were blanched. Upon examination, I

* Jennings, *Lancet*, 1882, vol. ii. p. 436.

found the os uteri fairly dilated, the right shoulder presenting; the membranes were unruptured, and the edge of the placenta could be felt just within the os uteri posteriorly.

At this critical juncture I remembered the cardinal rules laid down very clearly by Dr. Palfrey for the management of cases of this description—viz., to arrest hæmorrhage, to correct the malpresentation with the least possible shock, and by cautiously employing stimulants and restoratives freely, to *allow the patient to rally and deliver herself spontaneously*. A drachm of brandy with one of water was injected into the gluteal muscles; the membranes were ruptured, and the left leg brought down into the vagina with considerable ease, owing to the flaccid condition of the parts and the amount of general anæsthesia present. The abdomen was kneaded, the hæmorrhage ceasing. To have accelerated delivery at this period would, I think, have proved fatal. Two grains of sclerotic acid, in solution, were injected into the buttock, and the woman was covered with blankets. I left an assistant steadily kneading the uterus, and returned to the hospital for a transfusion-apparatus. Not being able to procure a blood-giver, it was determined to try a saline alcoholic intra-venous injection.

I may here observe parenthetically that great difficulty was experienced in finding a vein, owing to the profound anæmia existing. The patient's right elbow was immersed in hot water, and the cubital

triangle thoroughly sponged. These means, added to friction of the part and the adaptation of a turn of a bandage around the arm, were successful in causing the veins to stand out with some prominence; an incision was made over the median basilic, the vein exposed, isolated, and an aneurism-needle armed with a double ligature passed beneath it. The distal ligature was tied, the vein opened, the nozzle of a three-ounce metal syringe, charged with the fluid already prepared, inserted, the proximal ligature tied loosely over the nozzle of the syringe, and the piston pressed slowly home. This was about 6 p.m., the woman being moribund. The syringe was emptied; it was disconnected, refilled, and readjusted, the process being continued till sixteen ounces of the fluid had been injected. Signs of animation very rapidly appeared—recognition of people present, speech, vision, and hearing returned, and complaints of pain in the abdominal region were made. The syringe was withdrawn, the proximal ligature on the vein now tied tightly, the wound closed with the interrupted suture, and a compress and bandages applied. Another grain of sclerotic acid was injected hypodermically, and the case left to nature, delivery occurring at about 7.30 p.m., without *any further operative interference whatever.*

These cases I have narrated merely as good examples of the effects of two essential different kinds of treatment, nor are they by any means the

sole examples which could be adduced : from a fair experience of ante-partum hæmorrhage, I feel certain that whether prævial or accidental, as a broad rule, subject to very few exceptions, the plan of treatment advocated by Dr. Palfrey, though antagonistic to the views of many, is, *inasmuch as it is the most successful*, undeniably the best.

In ante-partum hæmorrhage it is usually an easy matter to draw down a foetal leg into the vagina, for this simple manœuvre is greatly favoured by the flaccidity of the soft parts, resulting from the serious hæmorrhage, to prevent the persistence of which this line of action is demanded.

This effected, the liquor amnii readily escapes, and the smooth, globular foetal head becomes opposed to the fundus uteri, the child forming a tampon of no small efficacy, besides being at once a *point d'appui* for the uterus to be stimulated to contract upon, by means of manual excitation, the subcutaneous injection of oxytoxics, and the exhibition of restoratives ; and what restorative can compare with transfusion ? The obstetrician's work now ceases : he need no longer be the skilled physician, but should become the patient nurse.

The only conceivable advantage in completing delivery *artificially* at this period is the possibility of saving the life of the child, but it must be remembered that when the interests of the child are opposed to those of the mother, it is almost universally admitted that the welfare of the latter rather than of the former should be considered ; nor must it be

forgotten that even under the most favourable circumstances, attempts to save the offspring will be probably futile, for it is nearly always premature, and often dead before the accoucheur's arrival.

Is not the rapid removal of the child by operative proceedings in obstructed labour one of the most active predisponents to post-partum hæmorrhage? Is not this danger, *à fortiori*, very greatly increased where the uterus is atonic as the result of acute anæmia? But if time be allowed for the uterus, stimulated by transfusion, to regain its contractility to an extent sufficient to expel the fœtus, there is every hope that with the careful management of the third stage of labour, sound contraction of the uterus will be ensured and avert a fatal hæmorrhage.

"In cases of hæmorrhage," writes Dr. Barnes, "during and after labour, it has been apprehended that the new blood transfused might again escape on the uterine surface. This source of failure may be overcome by the local application of perchloride of iron."*

"One more emphatic reason I would plead in favour of the early resort to this treatment" (*i.e.*, the injection of perchloride of iron) "is, that it is not enough to save bare life; we must save all the blood we can. For this reason, and having acquired confidence in the efficacy and safety of this crowning remedy, I never now lose time by persisting in other means that may fail, and which, having failed even partially, leave the patient the worse by the quantity of blood lost."†

* Barnes, *Obstetric Operations*, p. 584.

† *Ibid.* p. 559.

"The first idea of using this means in uterine hæmorrhage was suggested to my mind on reading that perchloride of iron had been injected into an aneurismal sac."*

Surely no surgeon short of a fanatic would in his wildest moments ever dream of thus treating an aneurism were any other recognised method available. Would he dare to trifle with precious life by adopting a remedy which, when once set in action, is entirely beyond command, and may procure instant dissolution, save under most urgent and peculiar circumstances? In the case of the aneurism, too, the vessels leading from it may often be compressed whilst the injection of the styptic is being carried out—a precaution inapplicable to the uterine vessels.

All will concur with Dr. Barnes as to the absolute and urgent necessity of checking the flow of blood from the uterus before resorting to transfusion, though it must be admitted that the abrupt introduction into the vascular system of a quantity of fluid, which, circulating amongst the uterine muscle-fibres, excites them to contractility, is in itself a powerful hæmostatic. I wholly dissent from this eminent physician as to the safety of the intra-uterine injection of perchloride of iron, and am disposed to believe that the use of this styptic is inadmissible in all save a few exceptional cases. Dr. Barnes admits that disastrous accidents have followed the subcutaneous injection of solutions of this salt into nævi. He even refers to

* Barnes, *Obstetric Operations*, p. 544.

many fatal cases. Is perchloride of iron less prone to cause coagulation of the blood in the patent uterine sinuses than of that in a nævus? Will not ice—a remedy nearly devoid of danger—compete most favourably with perchloride of iron as a hæmostatic? I can call to mind cases in which the former has succeeded in arresting hæmorrhage where the latter has failed. Never have I ever had any anxiety from the use of ice, but have had reason to regret when, following the custom of the day, I have resorted to perchloride of iron.

How many cases are recorded, and how many are not recorded, in which the patients have died whilst the nozzle of the injecting syringe was actually *in utero*? And are we always to believe they have succumbed to hæmorrhage, and not to embolism, the “crowning remedy” having been employed all too late?

“Mr. Kesteven relates a case (*Lancet*, 1874) in which a child died suddenly after he had injected five minims into a nævus on the head. There was no autopsy; but Mr. Kesteven thinks it was not the result of embolism. He attributes it ‘to spasm of the glottis from mental emotion.’”*

Here is evidence having direct bearing on the subject :†—At a discussion at the Obstetrical Society as to the danger of the styptic injection, Dr. Bantock related a case of accidental hæmorrhage to which he had summoned Dr. Barnes, “who arrived in due

* Barnes, *Obstetric Operations*, p. 547.

† *Obstet. Trans.*, vol. xv. p. 71.

course, and after a short delay extracted a small child with the forceps, dead. The placenta was at once removed, along with a considerable amount of coagulum, evidently the result of the primary hæmorrhage. There was then no hæmorrhage, and the uterus was well contracted ; but, taking into account the exhausted state of the patient, and the probability that any amount of post-partum hæmorrhage would prove fatal, he thought it advisable to inject the uterus with a solution of perchloride of iron as a measure of precaution. No sooner was the iron injected than the patient began to complain of severe pain in the hypogastrium." She died seven or eight hours afterwards. Dr. Barnes attributed the fatality to *shock*, *i.e.*, the shock produced by passing the nozzle of the syringe into the uterus.

Taking into consideration the fact that *the uterus was well contracted*, was the injection indicated at all ? Was it sound practice to anticipate the relaxation of the uterus, and the hæmorrhage which would attend thereon, by means of a *dangerous* prophylactic measure when one, alike powerful and free from danger (mechanical stimulation of the uterus), might have been readily adopted instead ? Or might not the transfusion of saline fluid have been performed with a great probability of success ?

Further, " Dr. Cory* showed the uterus and appendages of a woman (*æt.* 40) who died in St. Thomas's Hospital. She had been admitted on account of

* *British Medical Journal*, 1879, vol. i. p. 630.

uterine hæmorrhage, for which she had suffered for ten weeks since the expulsion of a vesicular mole. A fortnight after admission she had such a severe attack of bleeding that the resident accoucheur injected, by means of a Higginson's syringe, a solution of perchloride of iron through a long tube, which entered the uterus through a considerably dilated cervix. The woman became suddenly collapsed, and died almost before the tube could be removed. At the post-mortem examination a small quantity of darkish fluid was found in the recto-vesical pouch ; this contained a large amount of iron. A portion of vesicular mole still remained attached to the uterine wall. The fluid appeared to have entered the peritoneal cavity through the left Fallopian tube."

On hearing the account of this case Dr. Barnes considered there was *evidence of shock*.

After reading of many cases of this description—cases with which medical literature is only too crowded, and from some acquaintance with post-partum hæmorrhage, I am convinced the use of the styptic is inadmissible, except in those rare and extreme cases *where other hæmostatic measures have failed*, or are impracticable. I am convinced it would be well were every practitioner when next summoned to post-partum hæmorrhage, and a life trembles on the balance, very gravely to consider whether he can be justified if he throw into the scale against transfusion the intra-uterine injection of perchloride of iron—an agent whose specific action on the blood is quite beyond control.

CHAPTER IV.

ITS MODES OF APPLICATION.

GIVEN a case in which transfusion is imperatively and *urgently* demanded—one which will brook no delay (and that such an one *will* present itself, at some time or other, when least expected, to the unwary practitioner is beyond all doubt)—how shall the surgeon operate?

If immediate blood-transfusion, notably after Roussel's or Aveling's methods, be decided on, the following favourable conditions must be present for its due performance.

First, skilled assistance. I do not wish to assert that an able operator has not performed, or that able operators will not perform the operation single-handed, but I maintain there are very few who would care to undertake, and who would not most properly abstain from a serious procedure, which requires much nicety of manipulation.

It is unnecessary to call attention to the trouble often experienced in finding and opening a vein of the recipient and inserting a cannula therein (for owing to

the acute anæmia existing, the vessels are shrunk and collapsed) or that the anxiety of the operator in the case of double operation must very largely be augmented. This accomplished, "let the giver go to the bedside and place his arm alongside that of the patient," writes an eminent authority.*

Doubtless this procedure has been and will be successfully adopted ; in fact, a case is recorded† in which the blood-giver seemed to enjoy the operation, and offered useful suggestions as to its performance. But is not this unusual? It is notorious that the donor is most prone to faint. And should he be a heavy man, and the accoucheur not very powerful, will not the practitioner vote the operation a delusion and his art a fraud?

Secondly, a blood-giver, who cannot always be obtained at a moment's notice. There are many who regard venesection and transfusion as operations dangerous *per se*—physicians who will refer to cases in which accidents have happened, cases which have proved fatal, the mortality being directly attributable to the operation. Though I myself do not attach undue importance to these objections, nevertheless they apply with more than double force to direct transfusion, for there the risk involves not only the recipient, but also the giver, and that a healthy life.

Thirdly, the operator must feel confident that his apparatus is in working order, and must possess a

* Schäfer, *Obstet. Trans.*, 1879, vol. xxi. p. 335.

† Aveling, *Obstet. Trans.*, 1873, vol. xiv. p. 102.

reasonable hope that the method adopted will securely provide against the admission of air to the vein operated on and fibrination of the blood *in transitu*.

To take a partisan-like view of the question as to the best method for transfusion would defeat my object. There is undoubted evidence to show that the admission of air to the venous system during operations has not invariably proved mortal, nor has the accident always been followed with alarming symptoms. Fibrination of blood in the transfusion apparatus, too, may occur, yet the coagulum, by possibly choking the tubing, may not pass onwards into the vein of the recipient.

There is, however, grave reason to suspect that one or other of these accidents has often occurred, and has not been unattended with the most disastrous consequences.

I can but refer to the careful records made by eminent, acute, and highly competent and trustworthy observers, and leave the impartial reader to form for himself a judgment on the facts provided for him :

“The apparatus employed was the funnel and syringe of Dr. Blundell. The coagulation of blood was the greatest trouble which interfered with the performance of the operation. The instrument had to be washed out three times, owing to the coagulation during the check of the supply from faintness of the husband, but I believe no clot was injected into the vein. About five ounces altogether were injected at three separate times into the median

cephalic vein, with the assistance of my clerks, Dr. Cook and Mr. Soper. She died two hours after delivery." *

Again, "After a few drachms had been transmitted Dr. Meadows thought he felt the skin rising near the incision, and suggested that the tube was not in the vein, but in the cellular tissue beside it. This proved to be true, and the tube had to be taken out and inserted into the vein. Its collapsed condition and the want of light made this no easy task; but it was at length effected."—"This accident," adds a footnote, "has occurred several times. In the *Lancet*, Feb. 26th, 1851, a case is related in which it proved fatal." †

Is not Aveling's instrument described as possessing cannulæ, the one rounded-pointed for the emittent vein, the other bevelled-pointed for the recipient vein, which when inserted are to be maintained *in situ* by assistants? ‡ Once more, is skilled assistance always obtainable when required? And if the cannulæ be held in the veins by competent assistants, may not those assistants perchance allow them to slip out?

The chief advantage claimed for Roussel's instrument is that the emittent vein is opened with a lancet, contained within a kind of cupping glass, so that a cannula need not be inserted into the giver's vein.

* *Guy's Hospital Reports*, 1869, vol. xiv. 3rd series, pp. 7, 9.

† Aveling, *Obstet. Journ. Gt. Brit.*, 1873, p. 304.

‡ Idem, *Trans. Obstet. Soc.*, 1864, vi. p. 132, *et seq.*

This method bears, however, a prime objection, for there can be no certainty that the lancet will not perforate the posterior wall of the vein, and injure subjacent structures.

With its many stopcocks, its india-rubber bags, and other complex contrivances, all tending to cause the instrument to become readily disordered from disuse, it is hardly ever likely to find favour. It is not now to be found in the extensive armamentarium of the London Hospital, and very few of the instrument-makers in the capital keep it in stock.

Who can answer the searching question, "If immediate transfusion by the methods commonly advocated be a *practical* operation, why is it so rarely performed, when the indications for it, though not of very common occurrence, are by no means rare"?

It can scarcely be wondered that the lower animals should have been selected as blood-givers, from the very earliest time, in place of man. The arguments which have been urged in favour of using alien blood are these, that no risk to a healthy human life is incurred; that an animal suitable for the purpose can be readily procured; that blood can be obtained in large quantity, and, provided it be drawn from an animal whose corpuscles are not larger than those of man, the employment of the alien blood will be unattended with any special danger.

Only the first of these arguments can be conceded to. As a matter of fact, it is generally easier to procure a man for a blood-donor than a lower animal.

If transfusion be demanded for a farmer's wife in the dead of night, whether is it the easier to abstract a lamb from the sheep-fold or to transfuse from the farmer himself?

If the operation be needed in a large city, do sheep, dogs, pigs, or men most of all abound?

That, so far as our knowledge goes, the transfusion of alien blood is dangerous in small quantities, and always fatal in large, the following paragraphs will prove :

Dr. Aveling, in the *Obstetrical Journal*,* narrates a case of "transfusion of lamb's blood" (nine ounces). The patient died within one hour; but several successful Continental cases are recorded.

Have the Continental cases been so very successful?

Hasse's earliest communications † were enough to show that direct transfusion of moderate quantities of arterial blood from the carotid of a lamb into the veins of the human subject might exert a decidedly beneficial influence upon the constitutional symptoms in various forms of anæmia and marasmus. The roborant effects of this operation were repeatedly manifested not only in cases of acute anæmia, but also in the chronic anæmia of phthisis and other exhausting diseases. Hasse did not scruple to recommend his method as being both effectual and free from danger. Nevertheless, his own statements

* *Obstet. Journ. Gt. Brit.*, 1874, p. 223.

† *Cf. Ziemssen, op. cit.*, p. 482.

have made us acquainted with a series of pathological changes and peculiar symptoms more or less invariably consequent upon the transfusion of blood from an animal of another species, and quite unknown after the transfusion of defibrinated human blood.

It is not till after the patient has run the gauntlet of these dangers that he begins to feel the benefit of the operation. A feeling of imminent suffocation and actual syncope was frequently observed when the blood was allowed to flow into the veins too rapidly and for too long a time; but these are symptoms which have been noticed after the incautious introduction of large quantities of human blood. The symptoms I am now about to mention are, however, of a peculiar kind. Rigors, severe though brief, attended by a great rise of temperature, have been observed both by Hasse himself and by all his imitators. These rigors almost always occur during the twenty-four hours immediately succeeding the operation. Again, peculiar disturbances are not unfrequently developed in the kidneys, partial suppression of urine and hæmaturia being their most important symptoms from a clinical point of view (O. Hasse, Sander, Thurn, Klingelhoefer, Brugelmann, and others). Concerning some other less usual phenomena (extensive thrombosis in the vein employed for transfusion, phlebitis, etc.), I will say nothing; for, although their occurrence may possibly be connected with the transfusion of dissimilar blood, that connec-

ion is not susceptible of being proved. I will also pass over the risk of coagulation of the blood *in transitu*, a risk not wholly obviated by the procedure of Hasse and Gesselius ; for it is due to the blood not having been previously defibrinated, and it is obviously independent of its having been derived from an animal of another species.

The cause of the peculiar and violent febrile paroxysms (Hasse has himself seen the temperature rise to 107·6 deg. Fahr.) is still obscure, but the phenomena, though usually of short duration, ought to make us hesitate before we recommend the transfusion of lamb's blood for general adoption. The hæmaturia and associated disturbance of the renal function have, however, been fully elucidated by the laborious researches of Ponfick.

Ponfick ascertained that in dogs, rabbits, etc., neither hæmaturia, nor other grave symptoms, was produced by the careful injection of small or considerable quantities of blood, defibrinated or not defibrinated, taken from an animal of the *same species*, while relatively small quantities of blood from an animal of a different species always sufficed to ensure severe hæmaturia. When the quantity of dissimilar blood transfused was considerable, the operation was followed—no matter whether the blood had been deprived of its fibrin or not—by almost absolute anuria, speedily terminating in coma and death (within from thirty-six to forty-eight hours).

Peculiar alterations in the kidney are invariably

found in animals who succumb to the operation, and in those less seriously affected who are killed for the purposes of examination. Both kidneys are always greatly swollen; large portions of the straight and convoluted tubuli are found blocked up by granular and blood-stained casts, a variable number of which may be detected in the scanty and sanguinolent urine. These appearances are sufficient to account for death; and, taken together with the symptoms presented during life, they entitle us to conclude, with a high degree of probability, that any considerable quantity of alien blood introduced into the circulation sets up an acute nephritis which tends, when at all severe, to a rapidly fatal issue, with uræmic symptoms and suppression of urine.

Nor did Ponfick's experiments stop here. This careful observer also showed that both immediate and mediate transfusion, when properly performed on animals of the *same species*, was quite harmless, yet if the blood were frozen and thawed before defibrination (by which process it was rendered "laky") hæmoglobinuria and the concomitant train of symptoms followed the introduction of this blood into the venous system. Ponfick also transfused from the fowl to the dog, afterwards examining the two kinds of blood thus mixed, and demonstrating microscopically that the alien were so acted on by autochthonous corpuscles that the hæmoglobin of the former was discharged into the plasma.

This series of experiments, coupled with the results

of the heterogeneous transfusions of Hasse and others, prove that plasma containing hæmoglobin exerts a peculiarly phlogogenous influence on the kidney, and that, therefore, the introduction into the venous system of alien corpuscles is not by any means the *only* method of transfusion to be dreaded, for any method whereby the hæmoglobin would be discharged from its corpuscular nidus must be denounced as unsound practice. In these experiments, too, we find an explanation why some physicians inveigh against the transfusion of *large* quantities of (human) blood. Are there not good grounds for suspecting that in indirect transfusion, the blood may become "laky" during the process of defibrination, and though the intravenous injection of a *small* quantity of this fluid might, though not innocuous, be at least not deadly, a *large* quantity might prove a lethal dose?

Dr. Braxton Hicks* has shown that by the addition of a *certain quantity of a solution† of phosphate of soda* to freshly-drawn blood will prevent fibrination. For ease of application Dr. Hicks's method is excellent. The donor can be readily depleted, and the solution of the phosphate added to the blood procured in a room apart from that in which the patient is lying; therefore the practical superiority of this method over immediate transfusion is obvious.

But evidence is lacking to show that it is sound

* Hicks, *Guy's Hospital Report*, 1869, 3rd series, vol. xiv. p. 7, *et seq.*

† Water, whose sp. gr. is elevated to 2·5 by the addition of phosphate of soda.

practice to introduce abruptly into the vascular system phosphate of soda in proportion far exceeding that which normally exists in the blood, and a record of four successive fatal cases, by Dr. Braxton Hicks, treated by his "new plan" must certainly tend to shake one's confidence in it. It is, however, only fair to add the two cases recorded in the same communication*—cases treated by the "old plan"—were fatal also.†

In 1839 James Blake‡ performed an elaborate series of experiments which demonstrated that, on those lower animals he subjected to the procedure, the intravenous injection of *small* quantities of strong solutions of the salts of potash and soda, particularly the nitrate of potash, rapidly proved fatal. Is the *phosphate* exceptional to the other salts of potash in its effects when introduced into the venous system?

Let the unprejudiced reader place one or two drops of Dr. Hicks's solution (at 100° Fahr.) on the surface of a well-cleansed finger. By pricking the finger with a needle through the globule a little blood will immediately rise into the solution, and the mingled fluid can at once be examined microscopically on a hot stage.

* Hicks, *loc. cit.*

† Judging from the careful record of the *second* of these two cases which I have quoted at length in the preceding chapter (p. 22), there is reason to believe that the rapid extraction of the child by an operative procedure was *the cause* of the post-partum hæmorrhage to which the patient succumbed; that the transfusion (by the "old plan") was perfectly successful, and indeed highly beneficial, *in no way causing the fatal result.*

‡ *Archives Gen. de Médecine*, 1839, 3rd series, tom. vi. p. 289.

The red corpuscles will be seen very rapidly to lose their biconcave outline, to increase in size, and become translucent.

If such changes take place under the eye of an observer, they will also occur with equal certainty in a Hicks's syringe.

What special changes precisely occur in the vascular system when a preparation of blood and phosphate of soda solution is introduced therein might most probably be elucidated by vivisection. Was not the great value of transfusion as a therapeutic method proved in 1665 in England by vivisection? Have not Ponfick's vivisections in a foreign country added most materially to our knowledge on this subject? And yet we are deterred from, or, at all events, seriously hindered in pursuing an investigation for the future benefit of our race by the arbitrary trammel of a restrictive and oppressive legislation, which, whilst sternly denying to us the right of experimenting on lower animals, in no way prohibits, and probably never contemplated the performance of experiments on men!

However, with the knowledge afforded by the microscope, and considering the unstable relation of hæmoglobin to the corpuscular stroma, as well as the free solubility of the former in Dr. Hicks's solution—with the experience derived from Ponfick's researches as to the highly phlogogenous action which hæmoglobin in plasma possesses on the kidney—and, above all, with Dr. Hicks's series of fatal cases before us, can we

be justified in adopting this method of transfusion, when there are others equally efficacious, more applicable, and free from special danger?

Indirect differs from immediate transfusion in this, that the donor being depleted by the ordinary operation of venesection, and the blood drawn tending rapidly to coagulate, fibrination is accelerated by means of whipping, so that the fluid subsequently injected into the vascular system of the recipient is not whole blood, but blood minus its coagulum.

The material advantages of the indirect over the immediate operation lie in the facts that the donor, often a near relative of the patient, need not be brought to the bedside of the recipient, that the risk to the donor is considerably lessened, and the entire procedure being divided into two distinct stages, the method is more manageable, and the operator requires much less assistance.

On the other hand, the blood drawn is exposed to the atmosphere—an atmosphere laden with germs—and is not transfused in its entirety, so that its value is diminished, and much of its quantity wasted. The borderland between the classes is occupied by Dr. Hicks's method, for though indirect in point of application, it simulates the direct method very closely, whole instead of defibrinated blood being transfused, as in the mediate operation.

The fallacies which beset this method have been pointed out in the preceding pages.

Schäfer's observations* on lower animals show that it is quite safe to inject into the vascular system a fair quantity of freshly-drawn milk, or of milk boiled after standing, but that it would be fatal to inject ordinary milk not so boiled, and that London milk is especially deleterious.

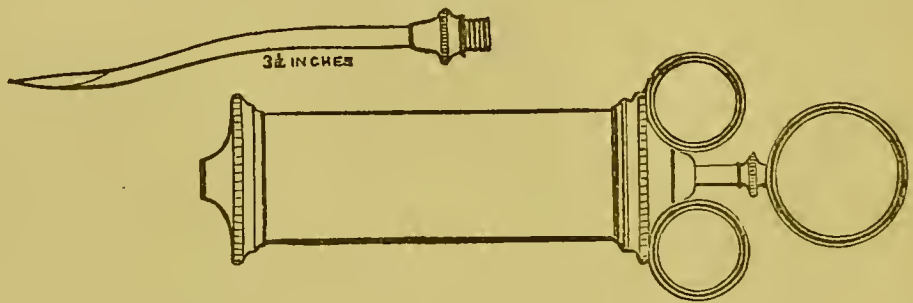
"An argument in favour of saline fluids" for intravenous injection "lies in the fact that the drained circulatory system labours not alone under the loss of the vivifying element, but also under the purely mechanical difficulty of vacuity. The heart and arteries have nothing to contract upon. Now the simple injection of ten or twelve ounces of fluid restores, to a certain extent, the dynamic condition of the circulation. And it is proved by Little's experience that saline solution is well tolerated." Thus writes Dr. Barnes,† and surely nothing can be more logical than his argument, and if to it be added the fact that, in cases of profound hæmorrhage, the process of absorption and assimilation is arrested, so that to administer stimulants and oxytoxics at such a period is simply childish; but if by means of blood-transfusion, or saline intravenous injection, the equilibrium of the circulatory system and of the all-important function of absorption be restored, the key to the rational treatment of severe hæmorrhage is found.

The woodcut illustrates the transfusion-syringe employed at the London Hospital, an instrument

* *Obstet. Trans.*, 1879, vol. xxi. p. 338, *et seq.*

† Barnes, *Obstetric Operations*, 1876, p. 579.

which, though efficient in the hands of an expert surgeon with able assistants, would prove unmanageable and dangerous under other circumstances. These are the disadvantages an instrument of this kind possesses: First, being made of brass, it is an extremely good conductor, and a deal of heat must therefore necessarily be lost from the fluid about to be injected; secondly, being of this metal, it is also non-transparent, nor does any glass interruption exist anywhere, in the syringe illustrated, for the purpose of affording observation; thirdly, the cannula is attached to the cylinder by means of a screw instead of "plugging-on;" fourthly, owing to



its small capacity (a capacity of less than three ounces), the component parts of the syringe have to be unscrewed and readapted many times, for the purpose of refilling it in order to inject a fair quantity of fluid. In the case I have quoted, sixteen ounces of fluid were injected before the good result was obtained; and the operation was at once desisted from, for though wishing to inject a larger quantity, with the view of increasing the dynamic effect, I was mindful that the risk of admitting air to the venous system, whilst replenishing the syringe, was extremely great.

Two other objections to this instrument may be mentioned. It must be filled *by an assistant*, for the fingers of one of the operator's hands being engaged in maintaining the cannula *in situ* within the vein, and preventing the access of air to it, it is impossible for him to charge the syringe with his other hand. Further, during the process of transfusion, the fluid in the receptacle is speedily cooling, so that whilst at the commencement of the operation, in the case cited, the thermometer in the basin of fluid stood at 100° F., towards the close of the procedure it had fallen many degrees.

Since the liability of a cannula to slip out of a vein into which it has been inserted is very great, it must be acknowledged that every transfusion cannula should be provided with a suitable groove for a ligature, which should invariably be applied. It may be mentioned in this connection that given a vein opened, a cannula inserted therein, and transfusion commenced, if proper precautions be not adopted, blood will emerge from the wound in the vein immediately on the distal side of the cannula, and if not prevented, will also flow from the opened vein before the insertion into it of the cannula, to the annoyance of the operator. I very strongly support the advice annunciated many years ago in primitive English that the operation should be performed "by making ligatures on the veines, and then opening them on the side of the ligature towards the heart."*

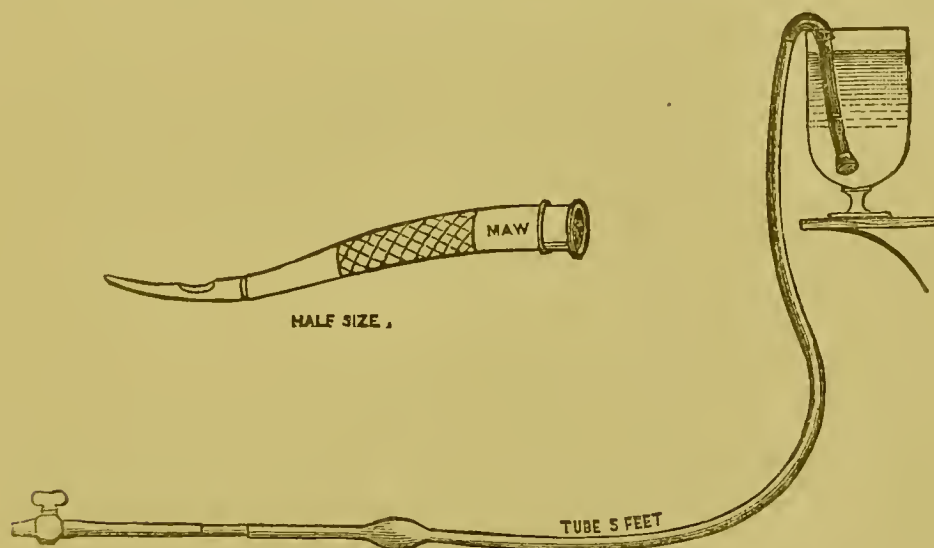
* Aveling, *Obstet. Journ. Gt. Brit.*, 1873, p. 289.

Since transfusion must be performed, though always deliberately, generally with rapidity, a cannula having the following characteristics will greatly aid the operator: an extremity which tapers to a point—a point, however, not sufficiently sharp to perforate the wall of the vein whilst lying therein; a part engraved or embossed, where held by the fingers, to afford a secure grasp; a serpentine form, which will not only favour ease of introduction, but being so shaped, the instrument when introduced within the vein will not displace it from its surroundings by dragging on the integument, as will one of any other form, unless maintained *in situ* by the hand. Last, but not least, the aperture for the egress of the blood or saline fluid should be some little distance from the point of the cannula, that it may be closed by the pulp of the operator's index finger while the point is being inserted into the opened vein.

To open the vein by cutting a flap in it with a scissors, as recommended on high authority, instead of by means of a puncture with the scalpel, is a needless complication, having the disadvantage of wasting time, which the use of an additional instrument involves. What surgeon, performing tracheotomy, would elect to open the trachea with a scissors?

The engraving illustrates a syphon I have devised for intra-venous injection. A piece of rubber tubing, five feet in length, provided with a small bulb for exhausting the air contained in it, prior to use, and a glass interruption in its continuity for the purposes of

observation, constitutes this instrument, which very closely imitates the common nasal douche. Where the tubing passes over the edge of the vessel containing the fluid for injection, it is protected from pressure by means of a semi-circular canal of vulcanite through which it passes. The extremity for the ingress of the fluid is guarded by a metallic grating, that for its egress by a stopcock, to which a cannula, of size suitable for the vein selected for operation, can be "plugged-on."



It has been objected that the fluid, in passing through five feet of tubing, will lose much heat. From experiments with regard to this point, it appears that owing to the fact of india-rubber being a bad conductor, only a fractional part of a degree of heat is thus lost. The temperature of the fluid can be estimated, sufficiently well for practical purposes, by inserting a thermometer in the receptacle; or with unerring exactitude by means of a thermometer con-

structed within the glass tube (near the cannula), and such an one has been made for me at Berlin.

A small case contains this syphon (made by Messrs. Maw, Son & Thompson), some cannulæ of different sizes, a pair of dissecting forceps, with five points, a scalpel, aneurism-needle and ligatures, a graduated bottle for alcohol ; there is also room for some saline powders, and for an automatic retractor, which will be found most useful in the performance of the operation.



Each powder contains—

Chloride of Sodium	50 grains
Chloride of Potassium	3 „
Sulphate of Soda	2·5 „
Carbonate of Soda	2·5 „
Phosphate of Soda ($\text{Na}_3 \text{PO}_4$)	2 „

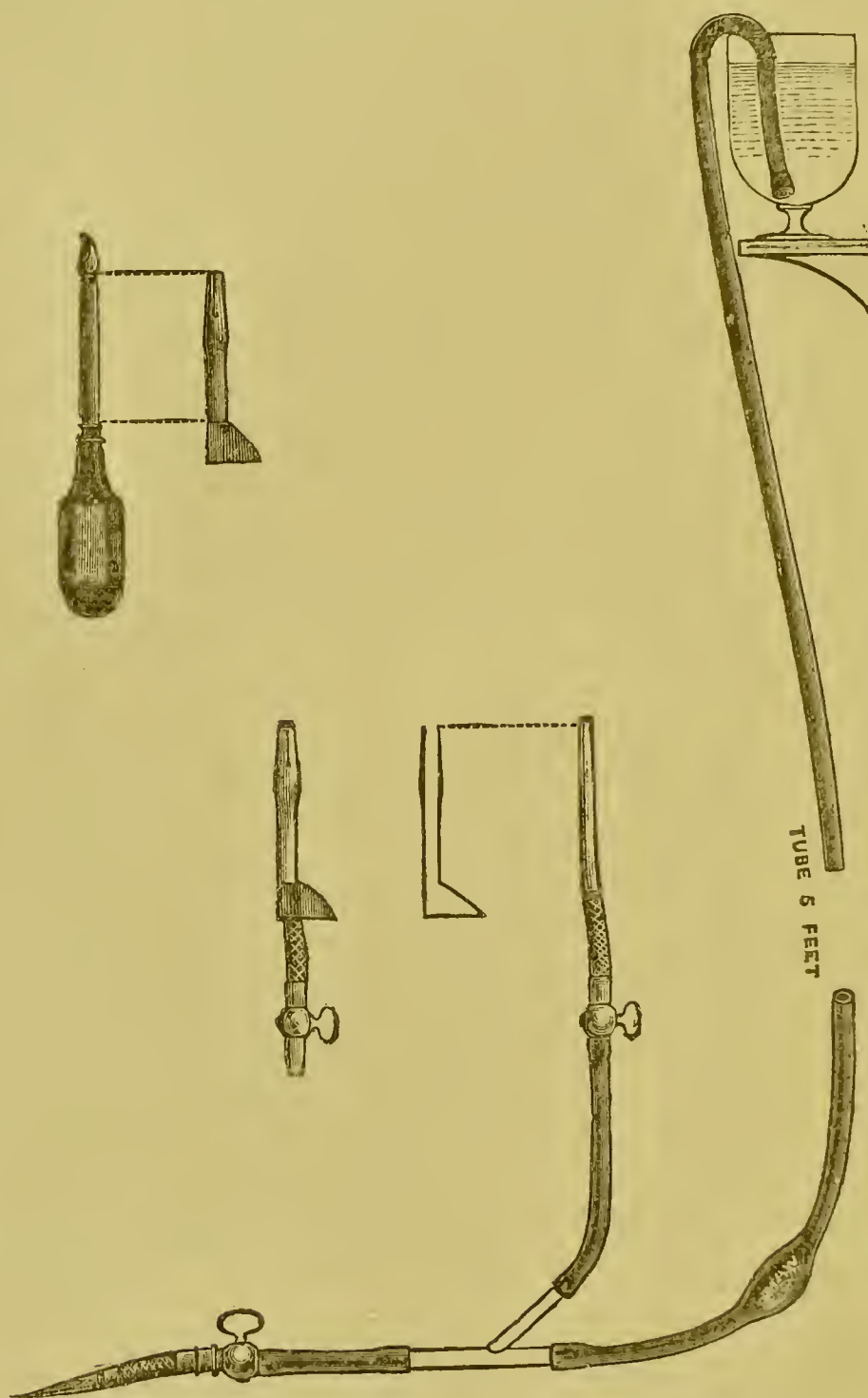
If one of these powders be dissolved in twenty ounces of water at 100° Fahr., and two drachms of absolute alcohol be added, a solution, similar to that employed by me in the successful case I have quoted, is at once produced. The syphon can be charged almost instantaneously, the air in it being expelled by compressing the bulb, the method being too obvious to require any explanation.

Since this syphon has been adopted at the London Hospital, it has there many times been successfully employed, and the advantages I claim for this instrument have been practically demonstrated. The explanation of the success usually consequent on saline intra-venous injections lies in this, that it is the *dynamic* rather than the nutritive value of transfusion which is serviceable in the class of cases under consideration. If, however, a few ounces of human blood can be safely and readily obtained (*which is exceptional*), it is obvious that the quality of the saline injection will be much enhanced by the admixture of the blood with it, most of all if that blood can be transfused *by an immediate method*, and there are cases on record which amply prove the accuracy of this statement.

A small addition to my syphon will render it applicable for the combined method; and it must not be forgotten that, whilst saline intra-venous injection is most valuable as a means of combating profound hæmorrhage, there are some conditions, such as carbolic acid poisoning, and idiopathic, progressive, pernicious anæmia, where blood-transfusion is indicated.

Should the operator be provided with a blood-giver and possess that skilled assistance without which very few would be disposed to perform immediate transfusion at all, let him substitute for the glass interruption in the tubing of the syphon a Y-shaped glass tube with a few inches of rubber and a cannula

and stopcock attached to the additional aperture.*
The instrument being charged with the saline fluid,



* This branch should be of less than half the calibre of the main trunk.

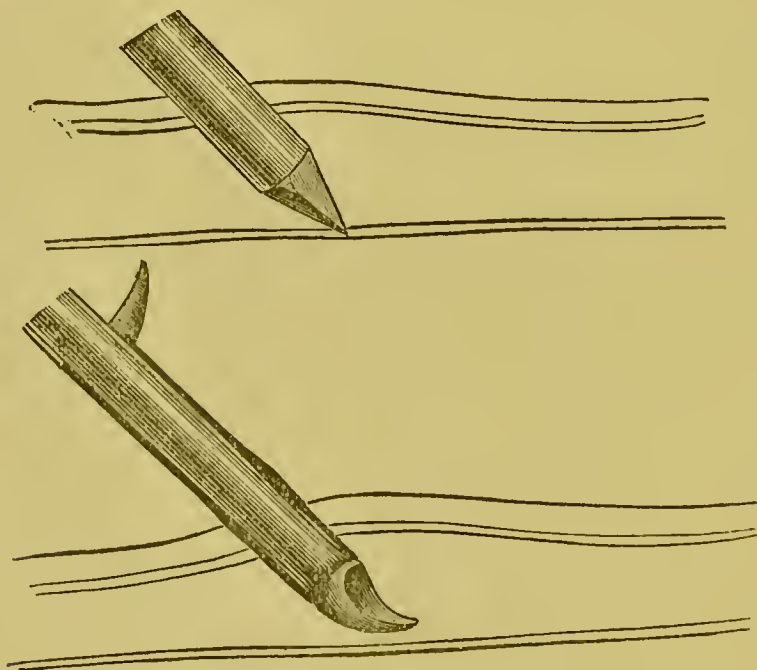
the recipient's vein opened, the cannula inserted therein, and the flow of the fluid established, let the donor be brought to the bedside, and the veins of his arm having been previously rendered prominent in the manner usual for phlebotomy, a trocar and cannula can readily be thrust into one of them in the distal direction. As the trocar is withdrawn, the blood will, of necessity, rush outwards through the cannula, *but no air will pass inwards*. Whilst the operator closes this cannula with his left thumb, with his right hand he grasps the serpentine cannula attached to the branch from the main trunk of the syphon, and turns on the stop-cock connected with it; whilst an assistant momentarily compresses the rubber tubing near the cannula in the recipient's vein,* the saline fluid escaping through the branch. The operator now inserts the branch cannula into that within the donor's vein. The assistant relaxes his pressure on the tubing near the afferent cannula, and the donor's blood, which mingles with saline fluid in the functional tube, passes onwards rapidly into the patient's venous system.

An important feature in the value of this combined method is, that when the donor faints from loss of blood, that loss can instantly be supplemented by a few ounces of the saline fluid; for, by turning off the stop-cock of the afferent cannula, the saline fluid will imme-

* If he have no skilled assistant, the operator can turn off the stop-cock (close to the recipient's arm) previously to tapping the blood-donor.

diately flow in the reverse direction into the donor's veins. This substitution of saline fluid for blood may not at first sight appear so valuable as it really is, but the vascular system will be repleted thereby, and this is the chief argument on which transfusion for hæmorrhage is based.

The trocar and cannula I have devised for phlebotomy possess these special details: The point of the trocar is pen-shaped, with its tip turned up, in order to avoid the posterior wall of the vein operated on, which would most certainly be perforated by an ordinary trocar (as illustrated in the drawing). The



cannula is $1\frac{1}{8}$ inches in length, and provided with a slight shoulder, so that when once fairly within the vein it will in some measure be self-retentive. The shield of the cannula is deficient below the aperture, for were the shield complete, it would, by

pressing on the integument, prevent the instrument from lying evenly within the vein. The "inner" cannula (attached to the branch tube of the syphon) is similar to the afferent cannula, save that the terminal inch and an eighth of its length is perfectly cylindrical, and will accurately fit the "outer" cannula, into which it can readily slide.

I must express my thanks to Messrs. Maw, Son & Thompson for the great care they have bestowed on those minutiae on which the value of these instruments entirely depends.

The risk of fibrination must be much reduced by this method, for the blood, after passing through the efferent cannula and branch tube (which is very short), immediately mingles with more than twice its bulk of a saline fluid. The continuity of the flow, as regulated by the syphon, is most equable, instead of being intermitted by the jerks of the artificial heart in the shape of a rubber receptacle, to be worked by the hand of the operator, which belongs to most of the immediate transfusion apparatus in vogue. The substitution of a few drops of liquor ammoniæ for the alcohol directed to be added to the saline fluid for injection would materially assist in retarding coagulation. Nor should it be forgotten that the blood of males is less prone to coagulate than that of females. These facts, added to other considerations, certainly indicate that, as a rule, a male should be selected as the donor whenever blood-transfusion is demanded.

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THE END.

